

Optical Measurements of Tumbling Rocket Bodies

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ABSTRACT

A component of interest in the active debris removal (ADR) effort in low Earth orbit is spent rocket upper stages. Proximity operations for such missions require an understanding of the tumbling characteristics of these targets. This research was conducted to assist in laying the ground work for realistic ADR mission planning.

To better understand the tumbling characteristics of these spent upper stages, the NASA Orbital Debris Program Office has acquired over 400 recorded lightcurves using telescopes located in Colorado and New Mexico. This effort focuses on a population of over 250 Russian SL-8 and SL-16 spent upper stages. The oldest of these have been in orbit for 45 years, and some have exhibited unplanned orbit changes up to 22 years after launch.

This paper describes the techniques of how this optical data was acquired and summarizes the optical signatures for this population of targets, including categorization, tumbling period, and investigations into specific targets in which the optical signature changed dramatically over different time periods. Results from period analysis performed on these lightcurves are summarized.